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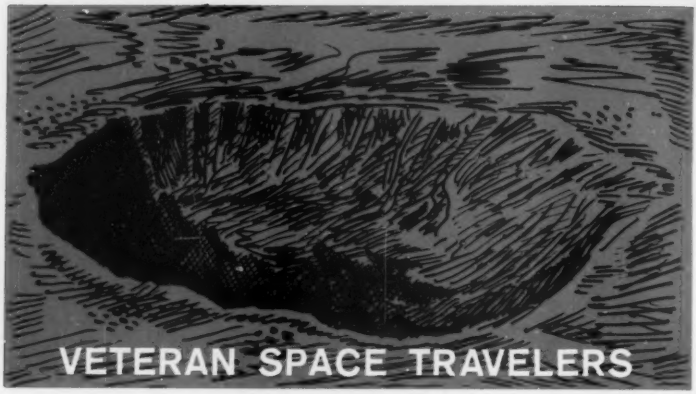

VETERAN SPACE TRAVELERS

METEORITES HAVE BEEN among earth's most persistent visitors since earliest time, yet there is much that is unknown and controversial about them.

Ancient man was familiar with meteorites. He used them as a source for the manufacture of iron tools, and he considered iron a celestial metal. But it was not until the beginning of the 19th century that science gave official sanction to the reality of meteorites.

Since the first authenticated fall in the 15th century, about 1,500 meteorites have been counted. One fall, however, might comprise many thousands of fragments, as for example at Pultusk, Poland, where the number of pieces that fell in 1868 was estimated at 100,000.

According to Dr. Brian Mason, of the American Museum of Natural History, studies of the frequency of falls in densely populated areas show a probable average yearly rate of "between 0.3 and 1.0 per million square kilometers," or "between two and eight falls a year in the continental United States."

The sizes of these bodies that collide with the earth range from bits no bigger than a pea to the 70-ton Hoba iron meteorite, which fell in South-West Africa. However, there is evidence of much larger falls. The origin of the Arizona crater, which measures 4,000 feet in diameter and 600 feet in depth, is attributed to the impact of a giant iron meteorite. E. R. Harrison, of Britain's Atomic Energy Research Establishment, suggests the possibility, in *Nature*, that the

Pacific Basin was formed as the result of a collision with a "planetesimal or a satellite of approximately 100-kilometer radius" which "excavated a large crater of several thousand kilometers in radius and some hundreds of kilometers in depth."

Meteorites also occur in the form of dust. Arthur Beiser, of New York University, reported at a meeting of The Academy's Division of Nuclear Physics that 250,000 metric tons per year is a "reasonable estimate" of the amount of dust fall. This dust, he added, "consists of particles from a few microns to 25 microns across. . . . "

There are three classifications of meteorites: iron, stony-iron, and stone. These meteorites began to strike the earth apparently in the late Quaternary period, several hundred thousand years ago. Studies of an iron meteorite found in Kentucky indicated it had a terrestrial age of about 600,000 years, calculated on the basis of the amounts of radioactive and stable nuclides produced in the meteorite by cosmic rays which bombard the meteorite in its flight through space.

Tektites (molten bodies), called glassy meteorites, are a possible fourth classification. However, they have never been seen to fall on earth, so their classification is in dispute. According to Beiser, the tektites, which are found only "in strata of the late Tertiary and early Quaternary periods," were discovered "almost exclusively in a latitude belt around the equator from about 40°N to 40°S," thus lending support to a theory that they are of lunar origin.

Writing in *Natural History,* Dr. Mason declared that stones are the most abundant meteorites and "show the greatest variety in composition and structure."

There are two groups of stones: chondrites, which contain chondri, small particles, usually one millimeter in diameter, consisting of olivine or pyroxene; and achondrites, characterized by the absence of chondri, which are much more coarsely crystallized.

Chondrites, which make up more than nine-tenths of all stones, include a small group known as carbonaceous chondrites. These contain 10 to 20 per cent combined water, organic compounds, free sulphur, calcium, magnesium sulfates an. hydrated iron-magnesium silicate. Only 19 carbonaceous chondrites have been found. They were recovered immediately after they were seen falling. Since they are very friable, they would not have survived long had they not been collected so quickly, Dr. Mason declared.

Stony-iron meteorites consist of approximately equal amounts

of nickel-iron and iron-magnesium silicate. Far fewer finds and falls of stony-iron meteorites have been reported than of iron and stone.

Iron meteorites are composed of almost 91 per cent iron, 8.5 per cent nickel, and 0.5 per cent cobalt. Studies reported in *Nature* have shown that iron meteorites can be divided into two groups: one containing lead of "primeval" isotopic composition; the other, containing lead of an "isotopic composition quite similar to that of common terrestrial lead."

The lead in meteorites accumulates as a result of radioactive decay of uranium and thorium, which are found in minute traces in all iron meteorites. Stone meteorites have more uranium and thorium than iron meteorites.

The origin of these space travelers is still cause of much speculation. The moon, Jupiter, the earth's volcanos, fixed stars, comets, and destroyed planets have been suggested as possibilities.

According to Dr. Mason, "meteorites presumably originated within our solar system since, like all other bodies in this system, they revolve about the sun."

To Beiser, meteorites "are probably fragments from the destruction of one or more asteroids, but conceivably might have been formed during the condensation of the solar nebula into the solar system. There is some controversy as to whether any of the sporadic meteorites follow hyperbolic paths, indicating an origin beyond the solar system."

In Harrison's view, meteorites "were not improbably the remnants of the birth processes peculiar to the Earth-Moon system. Either the objects were satellites of this system, or they were planetesimals which were swept up in some tens of millions of years, or possibly a combination of both."

Disruption of a planet between Mars and Jupiter early in the evolution of the solar system — which supposedly created the asteroids (some of them as big as 300 miles in diameter) — has also been advanced as responsible for the appearance of meteorites.

However, this explanation would account only for the iron, stony-iron and the achondrite meteorites, since a disrupted planet would presumably have been differentiated by the force of gravity into an iron core, a stony mantle, and a transitional stony-iron zone. A similar process is believed to have occurred when the earth solidified.

However, carbonaceous and olivine-pyroxene chondrites could not have been the product of a planetary disaster.

In Dr. Mason's opinion, the composition of carbonaceous chondrites shows they "have never been exposed to temperatures above 500°C. The texture and structure of both carbonaceous chondrites and olivine-pyroxene chondrites indicate that they have not originated in any body with a considerable gravitational field," since they obviously were not consolidated under pressure.

He added that carbonaceous chondrites may be "representative" of the "primordial dust" that exists in outer space. While the solar system may have originated as a cloud of this dust which gradually cohered into planetesimals which then "aggregated to form the planets," the carbonaceous and olivine-pyroxene chondrites may represent the "fossil planetesimals, leftovers . . . from the initial cloud of cosmic dust," Dr. Mason wrote, "from which our solar system grew." □ □

THE TERM "MAN KILLER" can be applied to only seven of the 100 to 200 species of sharks. This distinction is somewhat dubious even among the seven, since most shark attacks on humans are attributed to individual "killers" which develop, either by accident or environment, an apparent liking for human flesh.

According to William Travis, writing in the *New Scientist*, most sharks find human meat unpalatable and actively indigestible. Furthermore, most sharks are cowardly, and any potential prey that offers signs of aggressive resistance is usually left alone.

A man swimming in a calm manner in shark-infested, clear water

runs very little risk because he represents a "new (and therefore possibly fierce) large marine creature," Travis said. Splashing or kicking in an unrhythmic manner, however, would make sharks potential hunters, "for their responses would be triggered by the spasmodic shock waves which their senses would interpret as evidence of a living creature injured or in difficulties – a situation which they, as scavengers, would be quick to exploit."

The seven "killer" species are: Tiger Shark, a scavenger that infests many tropical harbors; Great White Shark, Blue Whaler and Mako, which cruise in all latitudes; Grey and Brown Nurse, usually found in lagoons, estuaries, harbors and other shallow coastal areas; Hammerhead, a dweller of continental shelf and reef areas; and the Ganges River Shark. All but the Mako, Blue Whaler and Great White Sharks live in tropical waters.

In the hunt and attack, these sharks utilize five senses of perception: the visual, which is generally poor; the olfactory, very keen; the tactile, to "identify" with fin or flank; the sonic, highly directional and by which fin beats and feeding noises of fish are received and interpreted; and the asdic, by which reflection of sound waves transmitted and received back by the shark under water indicates "bearing and distance."

Travis noted that since most sharks hunt by night or in dirty water, thus enabling them to approach their prey unseen, "it is natural that their visual sense should be poor." Living and moving objects, he continued, are "probably first noted by sonic means, then tracked down through the asdic sense. A dead or immobile food source would be located either by olfactory or asdic senses and investigated perhaps by tactile brushing . . . to establish its substance and suitability."

Travis described the final assault as a "frontal attack during which the top jaw of the shark . . . hinges upwards, causing the teeth to become erect and locked in position. The fish then over-rides its food to which, if the quarry is large enough, it is kept pressed by furious lashings of its powerful tail. . . . Should the object move at the last second . . . the shark will rush by without deviating . . . and its jaws will snap shut at the precise instant predetermined by its sensory apparatus. . . ."

When the Mako or Blue Whaler closes its jaws on its prey, the teeth stab into the quarry and hold; most of the other species shear off large mouthfuls.

Those sharks that attack man apparently are denizens of dirty coastal waters where environment has made them true scavengers, eating all that comes their way. Travis cited instances where attacks have occurred in harbors while a few miles away in clear, but shark infested, waters no incidents are ever recorded.

Once the shark has launched his final, frontal assault, there is little man can do to defend himself, according to Travis. The shark's skin is covered with a coating of overlapping placoid studs similar in structure to that of the teeth. To penetrate this hide, even above water, requires a very keen knife and a powerful thrust. Under water it is impossible.

The only effective remedy is to stay out of areas likely to be visited by sharks: harbors and estuaries, particularly during and after rainy seasons, when edible debris is washed into the sea; any point near the efflux of sewers and abattoirs, fish markets or turtle-catching stations; and, at night, anywhere other than beaches known to be "safe." □□

SPEECH AND PERSONALITY

ONE OF THE INTELLECTUAL problems of today derives from our realization that intelligence can misconstrue facts, that intelligence can consist in a detachment from, rather than a deeper involvement in, reality.

Those who primarily concern themselves with the study of human personality are finding abundant examples of the statement by H. A. Murray and C. Kluckholn in their article "Personality Information: The Determinants" (in *Personality in Nature, Society, and Culture,*

Knopf, 1948) that "Every man is in certain respects like all other men, like some other men, like no other man."

It would seem that "the nature of man" sticks out all over him, given the proper training and experiences to discern it. Mannerisms, gestures, and speech patterns are found to offer the skilled observer the means to a high degree of insight to an individual's life history and existing personality. Freud's intricate catalogue of speech disturbances (verlesen, versprechen, etc.) and lapses from standard fluent communication together with gesture patterns continue to figure importantly in modern medicine.

In a report before The Academy's Division of Psychology, Dr. George F. Mahl stated that in normal speech "there is on the average one of the non-ah disturbances for every 8 seconds actually spent talking (in addition, there is on the average one 'Ah' for every 10 sec. spent talking). In spite of these high frequencies," Dr. Mahl said, "most speakers and listeners are not aware of the vast majority of the disturbances they produce or 'hear'. Speech disturbances seem to be beyond the usual conscious control exercised in speaking. In addition, within wide limits these disturbances are not subject to social or linguistic control. All of these characteristics enhance the usefulness of the speech disturbance ratio as an anxiety indicator."

The deeper and broader the inferences the psychotherapist attempts to draw from speech patterns, the more he must consider factors other than "simple" anxiety. A number of patterns, however, have been demonstrated to be reasonably objective indicators of psychopathology, some nearly exclusively linked with anxiety.

Doctor Mahl categorizes speech disturbances as follows:

1. ". . . Ah . . ."
2. Sentence change. "I used to . . . The situation was unchanged."
3. Repetition. "I wanted . . . I wanted to leave."
4. Stutter.
5. Omission (of parts of words). "We comp (letely?) . . . we had to forget the whole matter."
6. Sentence incompletion. "He never cared if he . . . The two of us took the only course left to us."
7. Tongue slips. "Jeannette never hared cow we lived." It was one long agony between the bethroom and the badroom." "I hate his . . . hated his damned even temper."
8. Intruding incoherent sound. "If I see a girl now I'd like to take out, I just . . . dh . . . ask her." (Mahl's example.)

"It would appear," Dr. Mahl concludes, "that the speech disturb-

ance measure could contribute to the systematic investigation of many important questions about the process of psychotherapy. There are, of course, many other research problems of human behavior that require an objective assessment of anxiety for their solution. The material presented suggests that the speech disturbance ratio might be of value in these instances also. It can be used in any case where there is speech." □ □

ORGANIC REGENERATION

ORGANISMS PRESERVE LIFE by regenerating themselves on a more or less continuous basis. In man the process is so extensive that nearly one-third of the total protein intake is used for this purpose. Skin wear-and-tear is such that it is entirely replaced about once each month, while red blood cells are replaced at the rate of 20 grams per day.

Man, however, can hardly match the record of certain invertebrates. Protozoa are capable of reconstituting themselves from a remnant of less than one per cent, and the fresh-water polyp Hydra regenerates itself from a single tentacle.

Dr. A. E. Needham, Oxford University, has called regeneration "the active type of self-preservation which is the essence of life." Man, of course, is particularly eager to discover means of controlling the process. At present, there are two main investigative approaches: the morphogenetic, which deals with structural changes that can be seen by eye or microscope; and the biochemical, which is concerned with "ultimate materials and reactions."

A regressive-progressive sequence of events has been observed in the morphogenetic process. In animals that can regenerate ana-

tomically complex organs, a preliminary phase of tissue regression takes place. They return to a more youthful condition before forming the embryonic cells (blastema) that make up the regeneration bud. In the lower animals, there is less tissue-regression and the blastema are recruited mainly from wandering cells. The rate of activity with which the blastema proliferate, elongate and progressively acquire final shape and differentiation depends in the early stages on the adequacy of the nerve supply.

Writing in *The New Scientist,* Dr. Needham pointed out that although adult frogs do not normally regenerate lost legs, they can be made to do so if the nerve supply is augmented. Furthermore, the specific character of the regeneration bud is determined by the portion of the central nervous system servicing the region. Nature can err, as when a crab regenerates an antenna where there should have been an eye, or when the polyp Tubularia produces a head at both ends.

The later stages of regeneration resemble the development of an embryo: a center of growth and activity develops in the regeneration bud and the parts become increasingly independent of each other until the nervous system reintegrates them.

In the biochemical process, the destructive-constructive sequence of catabolism and anabolism corresponds to the regressive-progressive morphogenetic sequence. The catabolic phase, Dr. Needham said, is characterized by "high proteolytic (protein-degrading) activity" and increase of the water content of the tissues "in preparation for rapid growth." The local tissues are "acid in reaction and chemically reducing."

In the anabolic phase, all these properties are reversed and rapid protein synthesis begins with an increase of ribonucleic acid.

"An interesting link between biochemical and morphogenetic processes," according to Dr. Needham, "is the . . . discovery that when the head-tail polarity of a regenerating planarian is caused to reverse, the pattern of rates of protein synthesis also reverses."

During regeneration, a large number of substances are produced, each controlling one aspect of regeneration. "In planarians, a specific eye-inducing substance has been recognized," Dr. Needham reported. Other chemicals are organ-specific inhibitors. The liver and kidney produce self-inhibitors which circulate in the blood stream. If part of the organ is amputated, the amount of the inhibitor is re-

duced and regeneration proceeds until equilibrium is re-established.

An increased flow of nitrogen and other substances resulting mainly from protein breakdown distinguishes the catabolic phase. It is believed this may be due to the fact that excess protein may hamper regeneration. Animals will not eat for a time after injury, with the result that there is little flow. Planarians regenerate best if moderately starved. "Conceivably," said Dr. Needham, "the morning sickness of early pregnancy has something in common with this change in metabolism."

This type of reaction occurs in every type of stress to which the body is subjected, and it is followed by a recovery process with the contrasted anabolic properties.

Probably all forms of damage are manifestations of the tendency to disorder, according to Dr. Needham. This, he concluded, "may account for metabolic turnover, a continuous regeneration at the molecular level. . . . At the other extreme it seems quite reasonable to regard embryogenesis itself as a process of regeneration – of new individuals to replace casualties among the previous generation." □ □

LIVING BREAKWATERS

CHARLES DARWIN DESCRIBED REEFS as tombstones over subsiding land. Modern investigations of the origins and formations of reefs have thus far upheld the aptness of his description, but at the same time they have also revealed how much man has yet to learn about reefs, their formation, their composition, their resistance to wave erosion.

There are three types of reef: fringing, built out from the shore; barrier, separated from the shore – usually of an island – by a

lagoon; and atoll, enclosing a lagoon where there is no central land mass.

According to Harry S. Ladd, of the U. S. Geological Survey, "all wave-breaking reefs in the tropical seas are commonly called coral reefs, though . . . on many reefs the calcareous algae are the essential, and in some places the most abundant, contributors." These algae cement the coral framework into a solid mass of limestone.

Minor contributors among the reef builders are described by Ladd in *Science* as the encrusting and benthonic (bottom dwelling) Foraminifera, and such other invertebrates as sea urchins, mollusks, and tube-secreting worms.

An indication of the numbers of marine organisms that may be found on a reef can be seen from the explorations off the coast of California by Dr. Willis E. Pequegnat, of the National Science Foundation.

As reported in *Natural History*, Dr. Pequegnat and his colleagues uncovered on a siltstone reef, with a surface area of only 1,200 sq. meters, 330 species of organisms, "not including the protozoans, the more primitive flatworms, the nematodes, the annelid worms, and the small crustaceans," as well as "many species of sponges, hydroids, and ectroprocts" that have not yet been identified.

The "amazing ability of coral-reef communities to maintain a very high productivity and standing crop of organic matter, despite the fact that most reefs occur in the impoverished surface waters of tropical seas," is noted in *Endeavour* by Dr. T. F. Goreau, of the University College of the West Indies, Jamaica.

According to Dr. Goreau, "a remarkable feature of all reef-building corals is their symbiosis with unicellular algae known as zooxanthellae." It is Dr. Goreau's belief that the zooxanthellae, a member of the Dinophyceae group to which many of the free living marine flagellate algae also belong, played a major role in the evolution and growth of shallow-water coral reefs.

Development of "enormous communities," despite the constant pounding of the seas, was made possible, he declared, "when processes of limestone deposition became fast enough for the rate of accumulation to exceed the rate of loss by organic and inorganic attrition." A decisive factor was the "synergistic effect of the zooxanthellae on the calcification rate of corals."

According to Ladd, three distinct elements are involved in build-

ing such huge reefs as Eniwetok Atoll, where the limestone mass capping the volcanic foundation contains more than 250 cubic miles of limestone. These elements are: growth forms, organic cementation, and lithification.

Some of the algae and corals build porous and intricately branched spongelike structures that not only facilitate the constant supply of refreshing sea water to all parts of the organisms, but also break much of the force of the incoming waves by dispersing the water. Others grow as thin veneers that are efficient cementing agents.

Encrusting calcareous algae, such as Porolithon and other lithothamnia, bind loose fragments to the growing reef edge. These scalelike growths may even smother colonies of living coral, while the reef edge corals may form a calcareous veneering blanket extending over areas of living algae.

Organic binding apparently is the important process in providing stability and wave-resisting qualities in the reef margin, although in the wide flats behind the margin other processes of cementation take place, probably largely chemical. The living organisms concentrate along the windward side, where the most persistent wave attacks occur. This zone protects the remainder of the reef, thereby aiding its growth.

Although reef building is primarily a biologic phenomenon, such geologic processes as erosion and sedimentation become involved as soon as the first reef organism is damaged by wave attack, according to Ladd. "Thereafter, reef building is a combination of organic and inorganic growth."

"An over-all figure for reef growth, based on coral measurement," he declared, "is probably less than 14 millimeters per year."

This computes out to an existence of 50 million years for living breakwaters scattered over 50 million square miles of ocean. Their strength can be gauged from the fact that normal waves are estimated to expend energy of about 500,000 horsepower against the windward side of an open-sea atoll.

While reefs have been the scourge of unwary mariners for centuries, they have also provided man with some of his finest harbors, formed entire islands, altered shorelines of continents, and have affected the circulation, temperature and salinity of enormous areas of the seas. Further study of reefs should help bring about advances in biogeography, geomorphology, oceanography, petroleum geology, sedimentation, structural geology and geophysics, and related human activities. □ □

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